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SEMICONDUCTING TRANSITION METAL SILICIDES FOR
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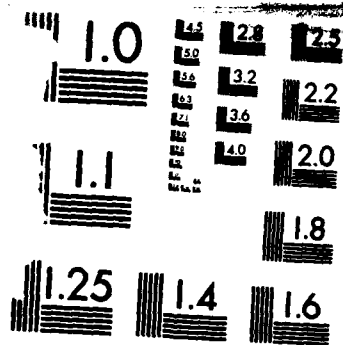
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SEMICONDUCTING TRANSITION METAL SILICIDES
FOR ELECTRO-OPTIC VSLI INTERCONNECTS

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PROGRESS REPORT #3

January 15, 1986

During the period since the last progress report, we have optically characterized the CrSi_2 samples, and fabricated thin films of $\text{MnSi}_{1.7}$ and $\text{IrSi}_{1.75}$. X-ray analysis of the latter two silicides has also been accomplished. These developments are summarized below.

Optical Characterization of CrSi_2

The spectral reflectance and transmittance of a representative sample are shown in Figure 1. A forbidden energy gap of 0.3eV is obtained from the onset of strong absorption at that energy. The interference fringes correspond to a refractive index-film thickness product of 10 microns; the estimated film thickness of 2.4 microns gives a refractive index of approximately 4.2 below the absorption edge. The strong absorption for the film above the absorption edge indicates an absorption coefficient of approximately $3 \times 10^3 \text{cm}^{-1}$. Because of this relatively low value of absorption coefficient, we tentatively identify the forbidden energy gap as of the indirect type. Computer analysis of the data is in progress.

$\text{MnSi}_{1.7}$ Formation and Analysis

Thin films of this material were formed by ion beam sputtering and furnace reaction techniques as described for CrSi_2 in our first progress report. X-ray diffraction analysis of the films confirms the presence of the semiconducting manganese silicide, with no other detectable phase except the silicon substrate. A diffraction pattern for a 1.5 micron-thick film is shown in Figure 2. Peaks belonging to the semiconducting manganese silicide phase are indicated, but the pattern cannot be indexed because the crystal structure

is unknown. Different textures were observed for the three substrate types (1-0-0 and 1-1-1 silicon, and polysilicon-coated wafer).

The room temperature resistivity of the material is 0.04 ohm-cm. Samples formed at 1000C exhibit a photoconductivity, upon illumination with a 6V microscope lamp, of about 0.04% of the dark conductivity. Preliminary transmittance measurements indicate a bandgap somewhat larger than that of the chromium disilicide.

IrSi_{1.75} Formation and Analysis

A representative X-ray diffraction pattern for a film formed at 750C is shown in Figure 3. Again, the data indicate the well-crystallized semiconducting silicide phase and no other except for the silicon substrate.

The room temperature resistivity for this material is on the order of 0.15 ohm-cm, with a photoconductivity as measured above of about 0.3% of the dark conductivity. Preliminary transmittance measurements also indicate a bandgap somewhat larger than that of the chromium disilicide.

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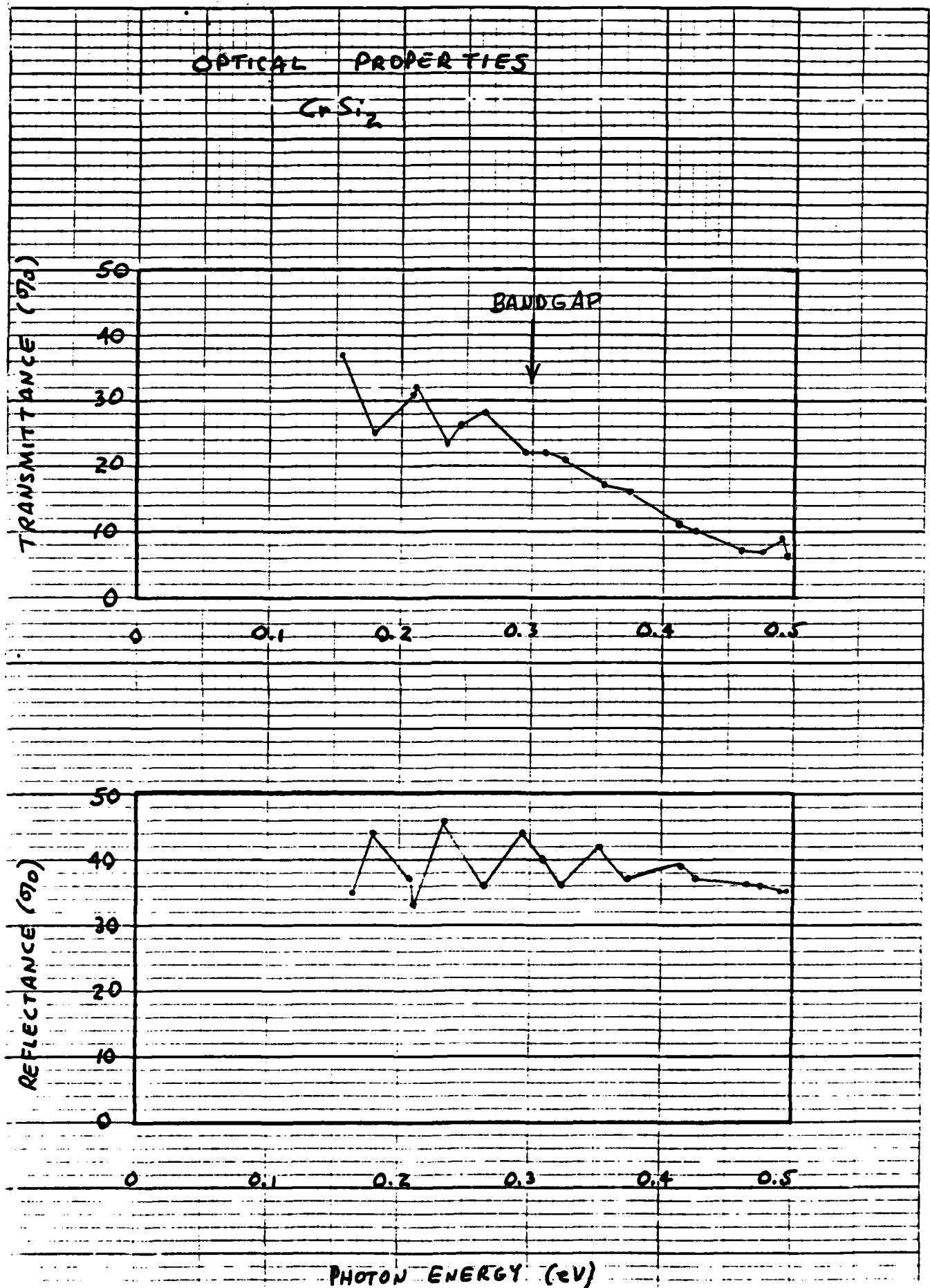
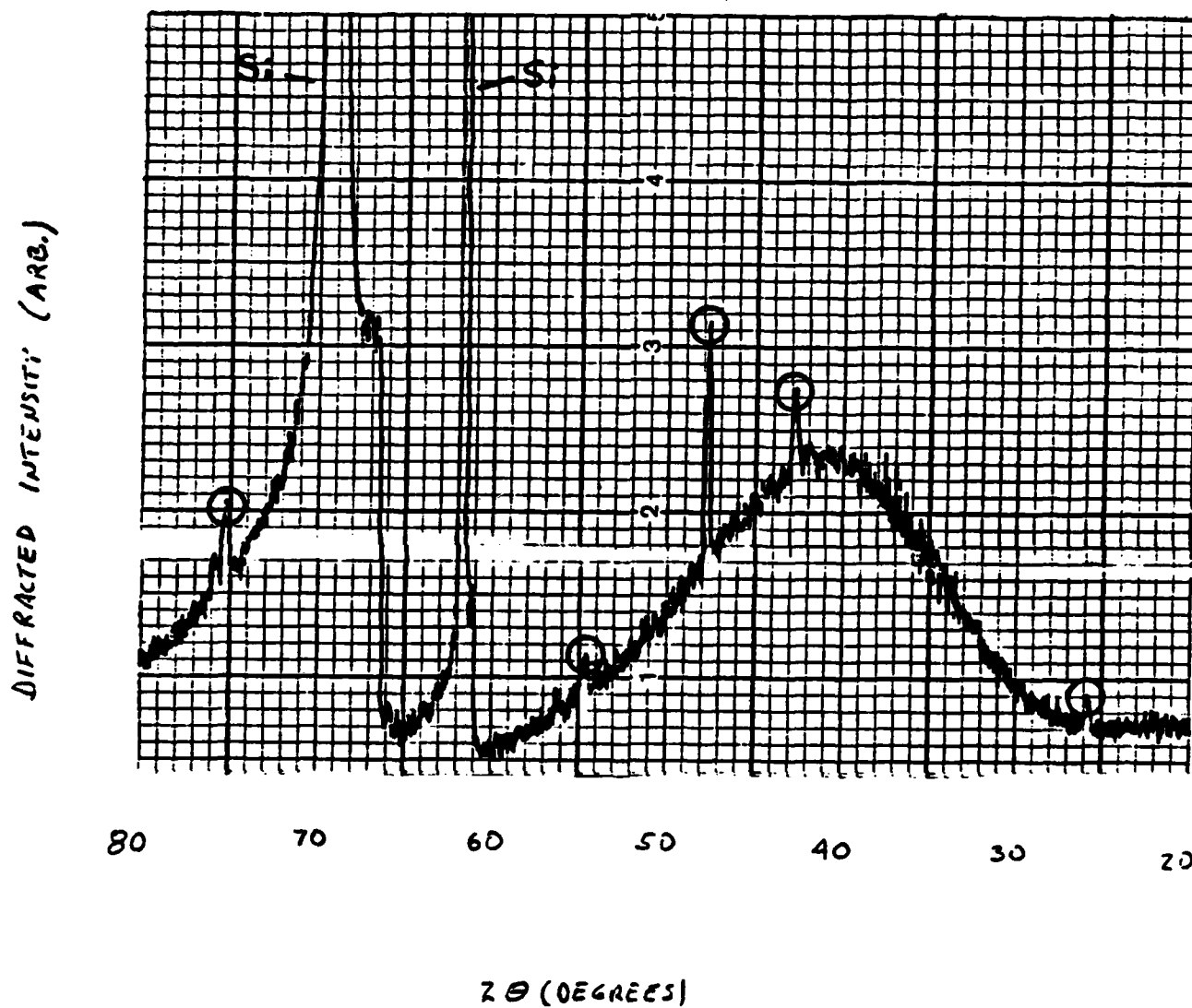


FIGURE 1

X-RAY DIFFRACTION PATTERN MANGANESE SILICIDE



($\text{MnSi}_{1.7}$ peaks are circled)

IRIDIUM SILICIDE



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